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RESEARCH ARTICLE

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Three new species of the genus *Toxoniella* (Araneae, Liocranidae) from Mount Kenya National Park, Kenya

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Abstract

Three new species of the genus *Toxoniella* Warui & Jocqué, 2002 of the family Liocranidae Simon, 1897 are described from Kenya: *T. tharaka* Oketch & Li, **sp. nov.**, *T. waruii* Oketch & Li, **sp. nov.**, and *T. nyeri* Oketch & Li, **sp. nov.** Types are deposited in the National Museums of Kenya (NMK), Nairobi, Kenya.

Keywords

Epigyne, shady forest, spider, taxonomy

Introduction

Spiders of the family Liocranidae Simon, 1897 are small to medium-sized (3–8 mm long) and live freely in diverse habitats such as heathland, dry and rocky areas, and sometimes in loose leaf litter or woody debris in shady forests (Roberts 1985; Deeleman-Reinhold 2001; Lecigne 2016; Platnick 2020). The family currently contains 33 genera and 290 species worldwide (WSC 2021; Li 2020). Before the current study, five

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liocranid species belonging to the genera *Andromma* Simon, 1893, *Cteniogaster* Bosselaers & Jocqué, 2013, *Mesiotelus* Caporiacco, 1949, and *Toxoniella* Warui & Jocqué, 2002 were known from Kenya (Kioko et al. 2021).

Toxoniella was first described in the family Gallieniellidae Millot, 1947 before being transferred to Liocranidae by Bosselaers and Jocqué (2013). It was formerly composed of two species: *Toxoniella taitensis* Warui & Jocqué, 2002 and *T. rogoae* Warui & Jocqué, 2002, both endemic to Kenya. *Toxoniella* can be distinguished from other Liocranidae genera by the presence of a posterior tegular extension without a sperm duct in the male palp, a vulva with two pairs of round spermathecae, legs with obvious spination, with anterior leg pairs less spiny than posterior pairs (Warui and Jocqué 2002). In this paper, three new species, *Toxoniella tharaka* sp. nov., *T. waruii* sp. nov., and *T. nyeri* sp. nov. are described based on somatic and genitalic morphology of both male and females.

Materials and methods

All specimens were preserved in 95% alcohol and examined and measured using an ocular calibrated scale bar in a Leica M205C stereomicroscope. Images were captured using an Olympus C7070 wide zoom digital camera mounted on an Olympus SZX12 dissecting microscope or an Olympus BX51 compound microscope. Male and female copulatory organs were removed, cleared in lactic acid, and washed in alcohol for a few minutes. They were then temporarily mounted on glass slides and photographed. Digital images were prepared using Helicon Focus version 6.10 image stacking software and subsequently edited in Adobe Photoshop CC 2020.

Leg lengths are given in the following sequence: femur, patella, tibia, metatarsus, tarsus. Measurements are given in millimeters. Elevation is presented in meters above sea level. Types are deposited in the National Museums of Kenya (NMK), Nairobi, Kenya.

Abbreviations:

AER anterior eye row;
ALE anterior lateral eye;
AME anterior median eye;
AW anterior width;
ATE anterior tegular extension;
d dorsal;
F femur;
MOQ median ocular quadrangle;
Mt metatarsus;
P patella;
PER posterior eye row;
pl prolateral;
PLE posterior lateral eye;
PME posterior median eye;
PTE posterior tegular extension;
PW posterior width;
rl retrolateral;
RTA retrolateral tibial apophysis;
SP spermatheca;
T tibia;
v ventral.

Taxonomy

Family Liocranidae Simon, 1897

Genus *Toxoniella* Warui & Jocqué, 2002

Type species. *Toxoniella taitensis* Warui & Jocqué, 2002 (by original designation).

Toxoniella tharaka Oketch & Li, sp. nov.

http://zoobank.org/501BF871-3C52-4ECE-A0E7-6C6DE695A3AC
Figs 1A–F, 2A, B, 3A–C

Material examined. ***Holotype*** Kenya • ♂; Tharaka Nithi County, Chogoria Town, Mount Kenya National Park, Chogoria Forest (bamboo vegetation); 00.1896°S, 37.4717°E; 2601 m; 20 August 2018; Oketch A.D. & Kioko G. leg. ***Paratypes*** Kenya • 4 ♂, 3 ♀; same data as holotype.

Other material. Kenya • 1 ♂, 4 ♀; Nakuru County, Lake Nakuru National Park, Nganyoi KWS Camp; 00.4903°S, 036.1858°E; 1856 m; 11 August 2018; Kioko G. & Joshua S. leg.

Diagnosis. Males of *Toxoniella tharaka* sp. nov. resemble *T. taitensis* and *T. rogoae* in general appearance but differ from both by having a short, blunt, slightly slanted RTA and a claw-like embolus. The epigyne resembles that of *T. rogoae* by having short cul de sacs but differs by having anteriorly directed cul de sacs (laterally directed in *T. rogoae*) and a wider epigynal groove (closed medially in *T. rogoae*). Additionally, the new species has a medially invaginated anterior epigynal margin instead of a smoothly recurved epigynal margin found in both *T. taitensis* and *T. rogoae* (Fig. 2A, B; Warui and Jocqué 2002, figs 4–6, 11, 12).

Description. Male. Total length 4.59. Carapace 2.60 long, 1.73 wide, yellowish brown with lines of grey setae radiating from fovea. Fovea thin, dark brown, longitudinal. Clypeus about two times the diameter of AME. All eyes have a dark ring around each of them. Eye diameters and interdistances: AME: 0.16, ALE: 0.12, PME: 0.10 and PLE: 0.12, AME–AME: 0.04, AME–ALE: 0.03, MOQ: AW: 0.15, PW: 0.18, Length: 0.18. Chelicerae elongated, brown, reddish orange in some areas. Sternum longer than wide, heart shaped, brown with conspicuous pre-coxal triangles and sparse setae. Labium longer than wide and colored as sternum. Endites longer than wide, about twice the length of labrum. Dorsally, abdomen with grey setae, reddish anteriorly, two pairs of brown sigilla and small brown dots fading towards spinnerets. Venter pale yellowish brown with mottling. Leg measurements: I 7.04 (1.90, 0.85, 1.82, 1.37, 1.10), II 6.06 (1.60, 1.00, 1.40, 1.16, 0.90), III 4.20 (0.68, 0.60, 1.12, 1.10, 0.70), IV 7.14 (1.90, 1.00, 1.50, 1.70, 1.04). Tibiae, metatarsi, and tarsi of anterior leg pairs have long, curved setae (trichobothria) dorsally that increase in length distally. The

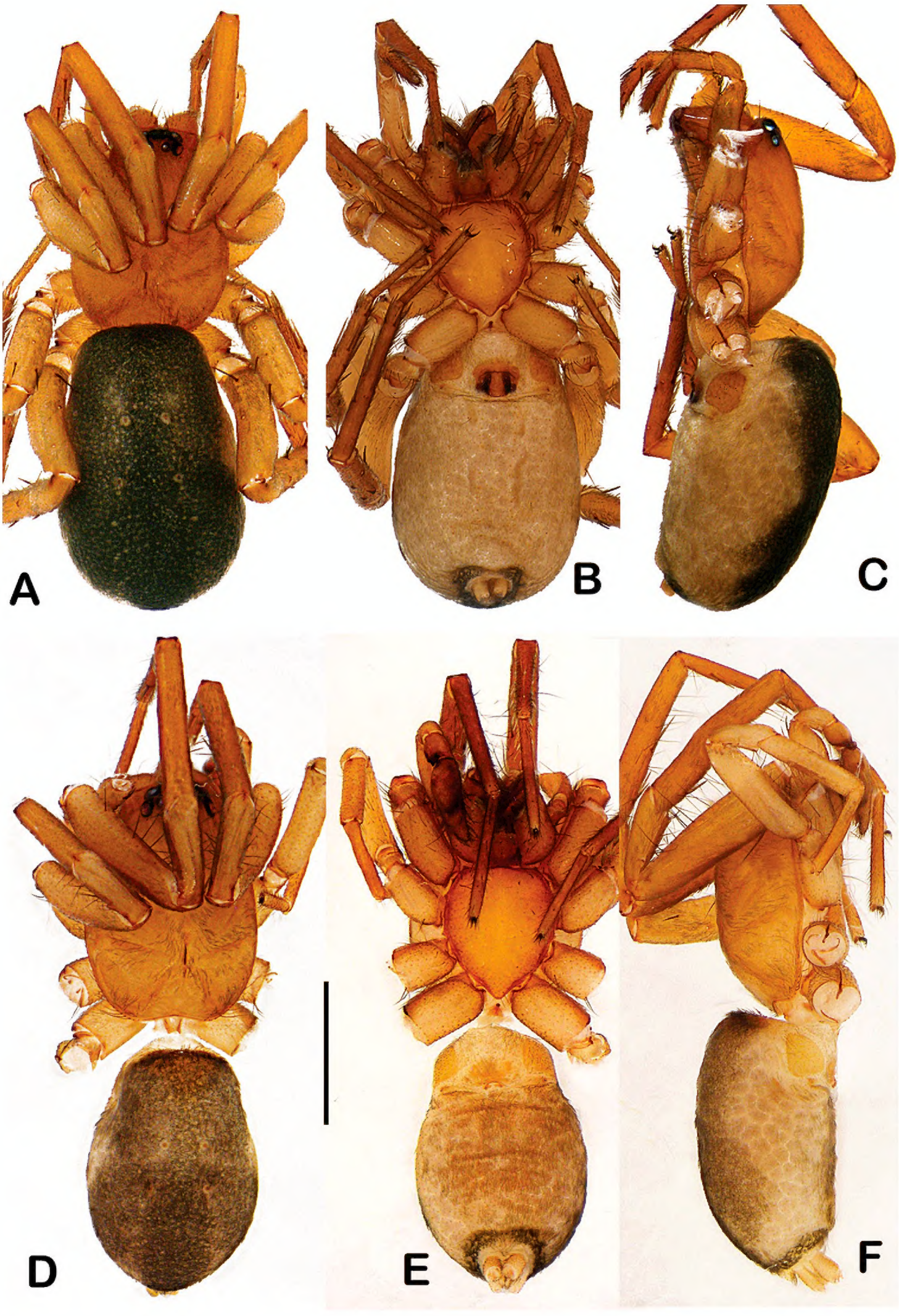

Figure 1. *Toxoniella tharaka* sp. nov., habitus, female paratype (**A–C**) and male holotype (**D–F**) **A, D** dorsal **B, E** ventral **C, F** lateral. Scale bar: 1 mm.

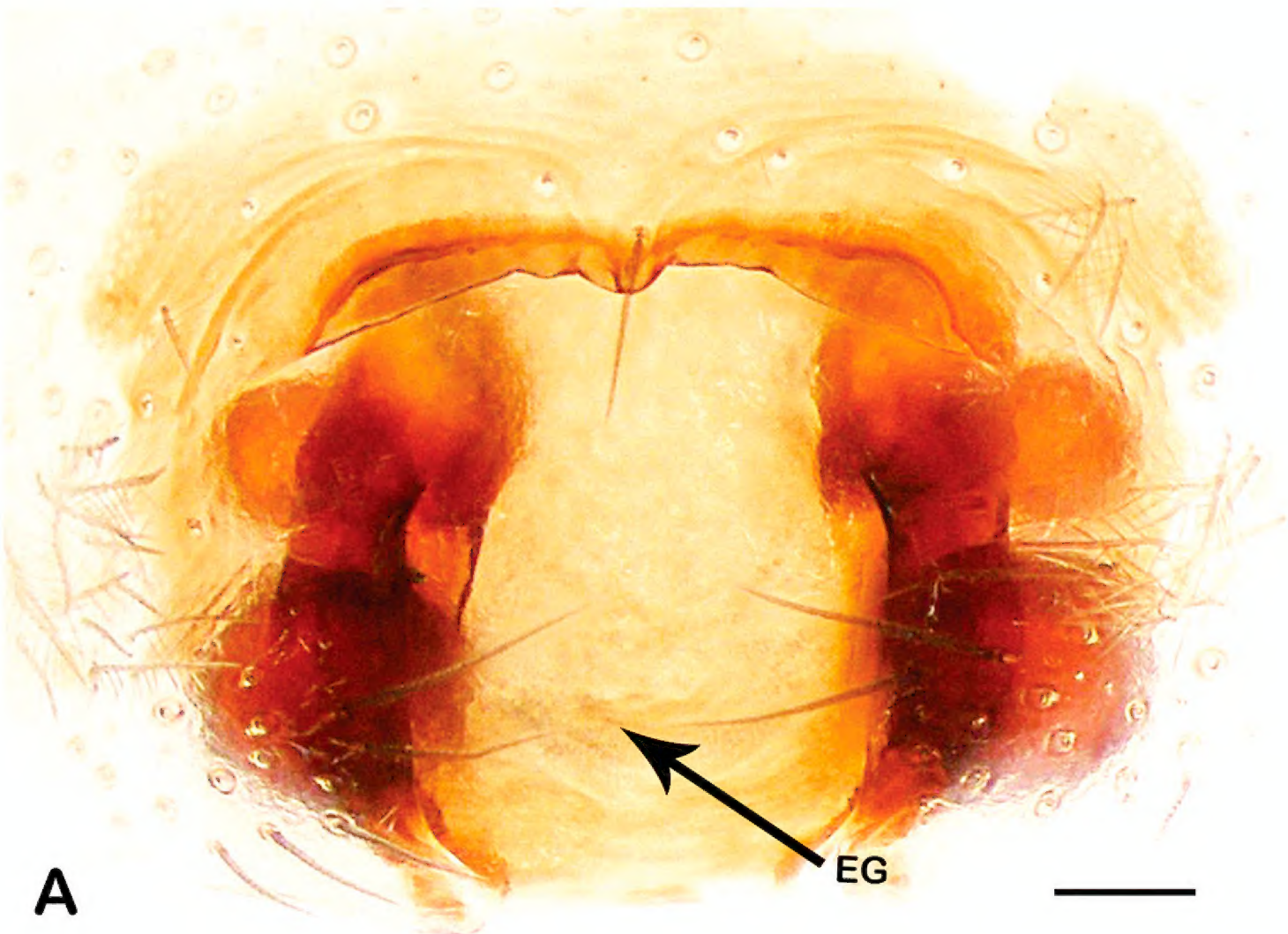

Figure 2. *Toxoniella tharaka* sp. nov., epigyne, female paratype **A** ventral **B** dorsal. Abbreviations: CDS cul de sac, EG epigynal groove, FD fertilization duct, SP spermatheca. Scale bars: 0.25 mm.

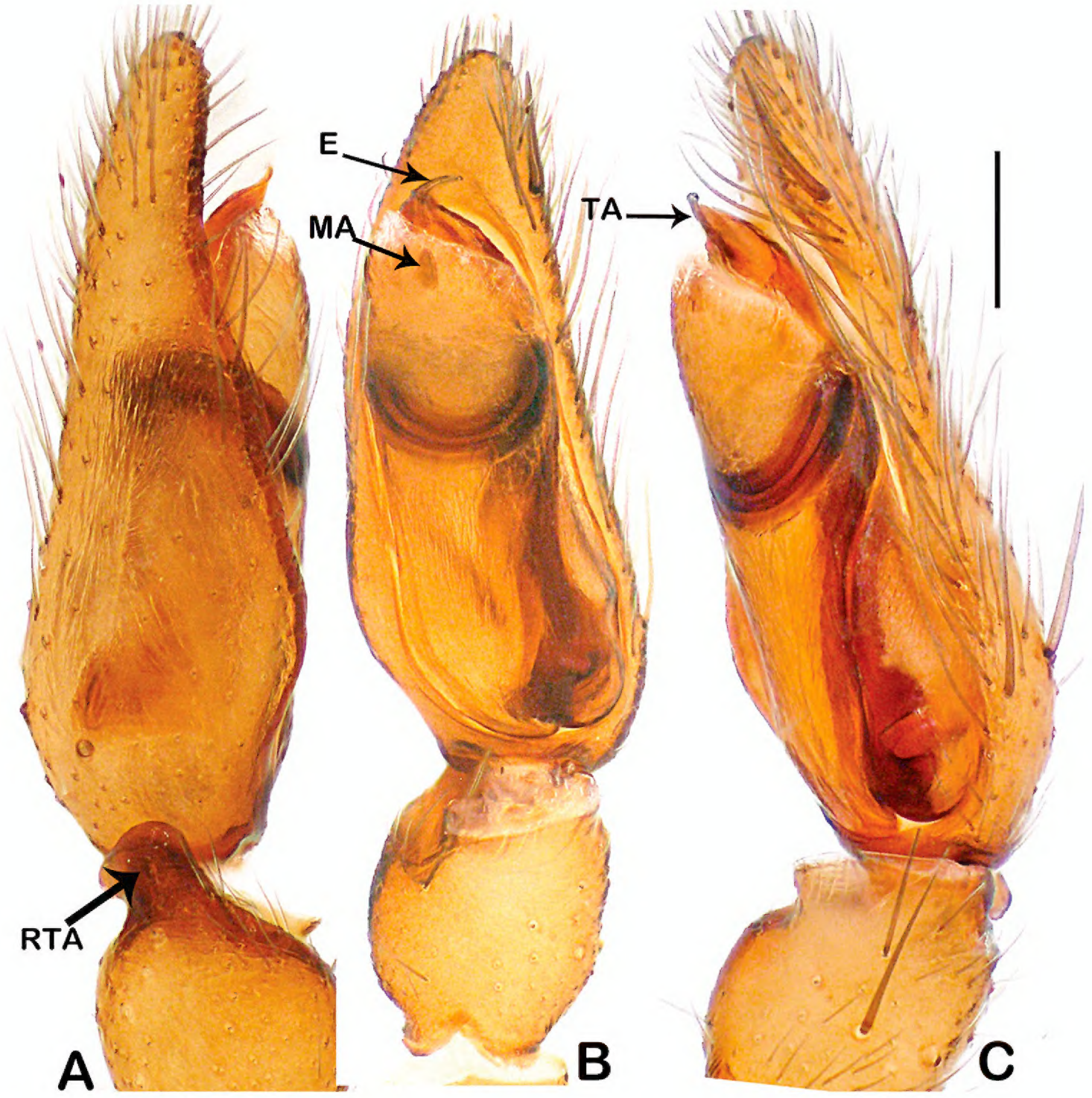

Figure 3. *Toxoniella tharaka* sp. nov., right palp, male holotype **A** dorso-retrolateral showing the RTA **B** ventral **C** prolateral. Abbreviations: E embolus, MA median apophysis, RTA retrolateral tibial apophysis, TA tegular apophysis. Scale bar: 0.25 mm.

tarsi bases have 5–6 pairs of slender tenant setae. Leg spination I: P–T v1–2–2 Mt v2–2–1; II: P–T v1–1–2 Mt v2–2; III: F P–T pl2, d2, rl2, v2–2–1 Mt 11; IV: F pl1, d1, rl1 P v1 T pl2, d1, rl2, v2–2–2. Palp as in Fig. 3A–C. Moderately elongated with blunt, stout, and slightly slanted RTA. Sperm duct U-shaped in ventral view. Embolus claw-like, tegulum apically membranous. Median apophysis small.

Female coloration as in male, with abdomen slightly darker. General body appearance as in Fig. 1A–C. Total length 5.72. Carapace 2.86 long, 1.93 wide between leg pairs II and III, pale yellow-brown, narrow at pars cephalica. Fovea as in male. Eye diameters and interdistances: AME: 0.17, ALE: 0.12, PME: 0.10 and PLE: 0.12, AME–AME: 0.04, AME–ALE: 0.03, MOQ: AW: 0.16, PW: 0.18, Length: 0.18. Chelicerae and sternum as in males. Leg measurements: I 6.40 (1.80, 0.80, 1.60, 1.20, 1.00), II 6.12 (1.40, 0.80, 1.20, 0.92, 0.80), III 4.90 (1.30, 0.60, 0.90, 1.10, 1.00), IV 7.20

(1.80, 0.90, 1.60, 1.80, 1.10). Long, curved setae dorsally on anterior leg pairs, and tenent setae as in males. Leg spination I: P–T v0–2–2 Mt v2–2–2; II: P–T v0–1–2 Mt v2–2; III: F P–T pl2, d2, rl2, v2–2–1 Mt 10; IV: P v1 T pl2, d1, rl2, v2–2–2. Epigyne (Fig. 2A, B) sclerotized, yellowish brown and medially invaginated on the anterior epigynal margin. Median groove wide, separating two pairs of globular spermathecae. Spermathecae outline visible through the epigynal plate. Cul de sacs are short.

Etymology. The species is named after type locality; noun in apposition.

Distribution. Only known from Kenya.

Toxoniella waruii Oketch & Li, sp. nov.

http://zoobank.org/2F7B24BB-4859-40AC-81BD-3376E03C252D

Figs 4A–D, 5A, B, 6A–C

Material examined. ***Holotype*** Kenya • ♂; Nyeri County, Naro Moru Town, Mount Kenya National Park, Naro Moru Gate; 00.1742°S, 37.1162°E; 2465 m; 26 Jul. 2017; Zhao Q. & Kioko G. leg. ***Paratypes*** Kenya • 2 ♂, 3 ♀; same data as holotype.

Diagnosis. Males of *Toxoniella waruii* sp. nov. resemble *T. taitensis* and *T. rogoae* by having a ridge-like RTA but can be distinguished from *T. taitensis* by an apically pointed, posterior tegular extension well-separated from the anterior tegular extension and a bent embolus with a membranous sclerite and from *T. rogoae* by having a flat,

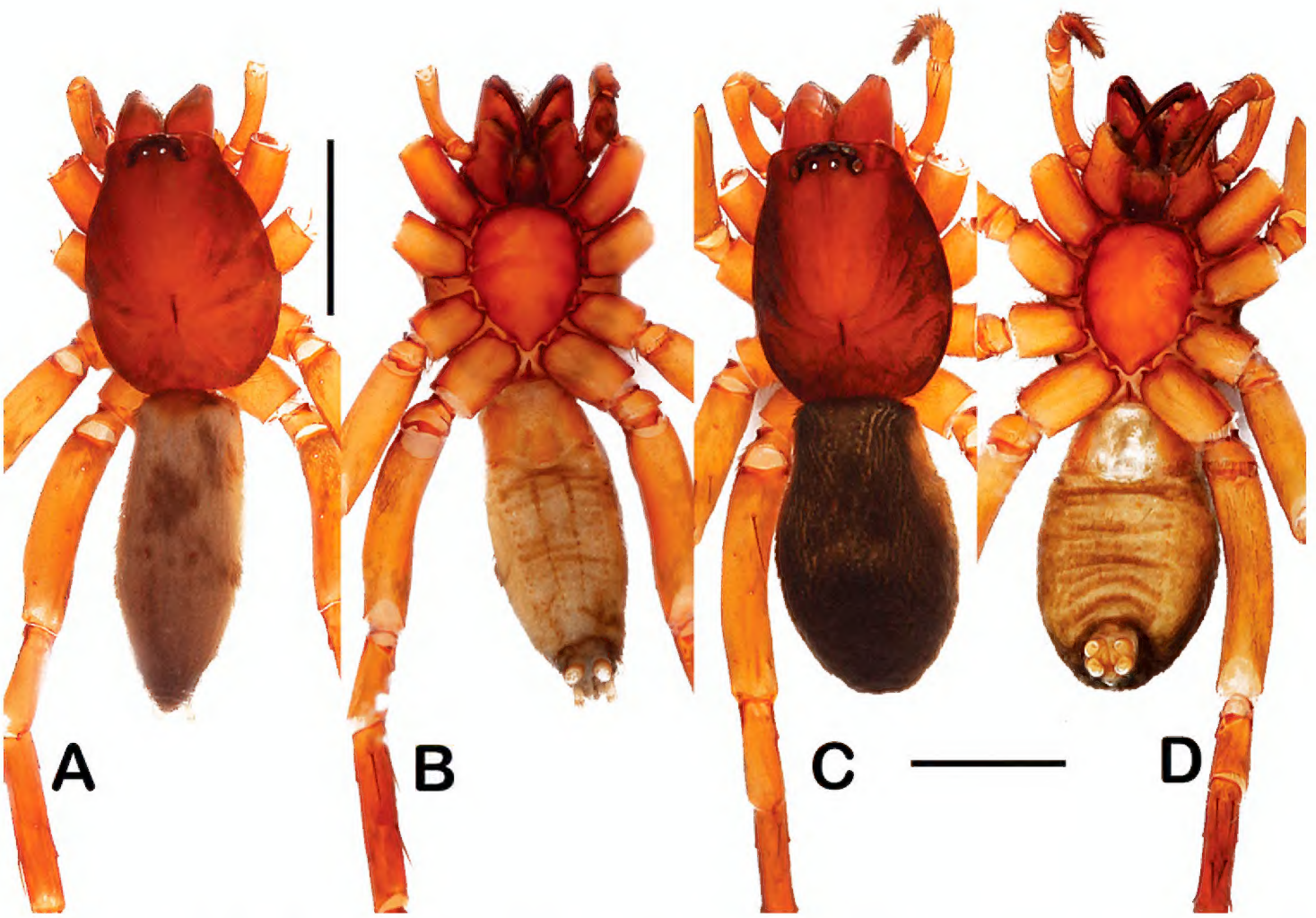

Figure 4. *T. waruii* sp. nov., habitus, male holotype (**A, B**) and female paratype (**C, D**) **A, C** dorsal **B, D** ventral. Scale bars: 1 mm.

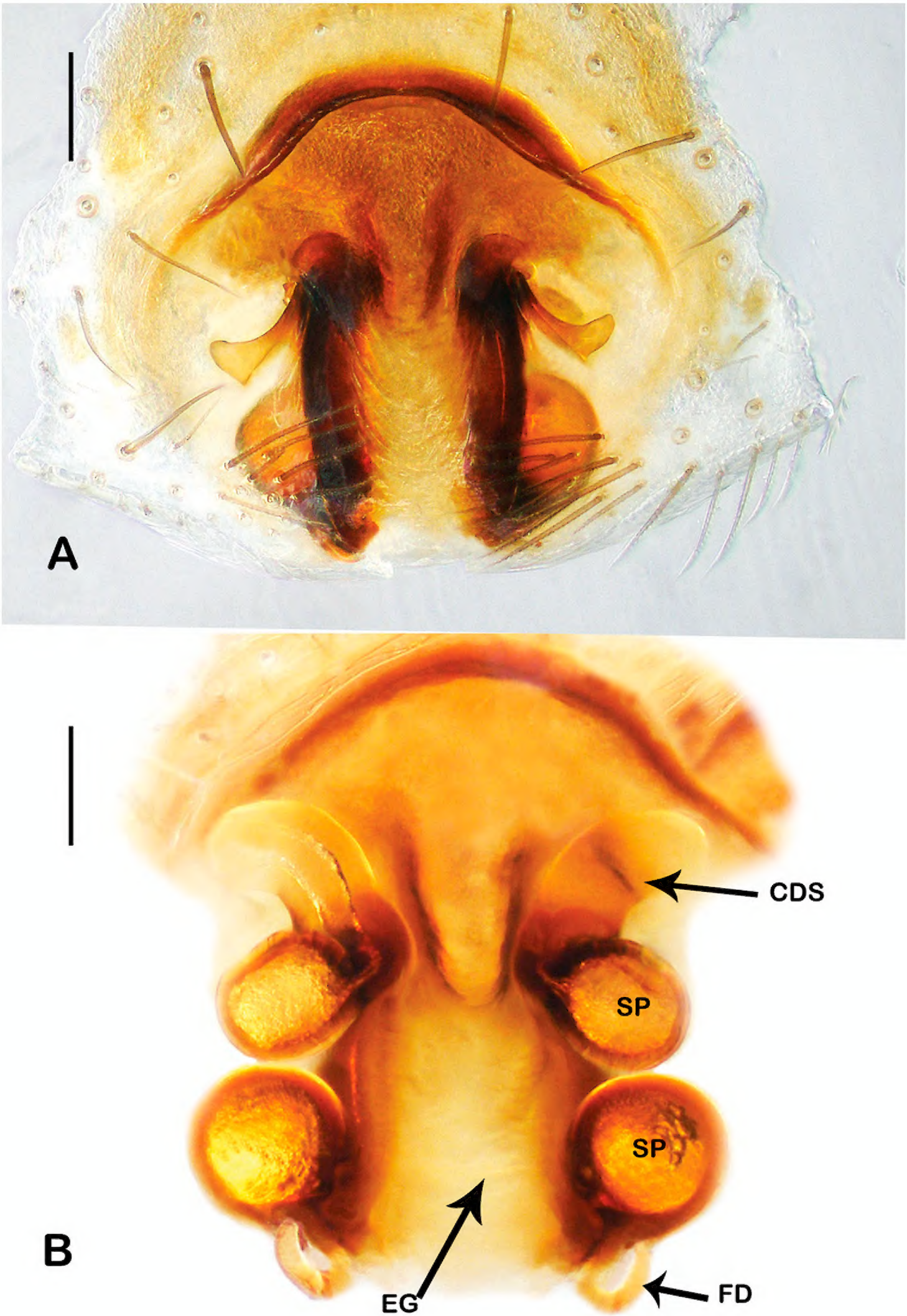

Figure 5. *Toxoniella waruii* sp. nov., epigyne, female paratype **A** ventral **B** dorsal. Abbreviations: CDS cul de sac, EG epigynal groove, FD fertilization duct, SP spermatheca. Scale bars: 0.25 mm.

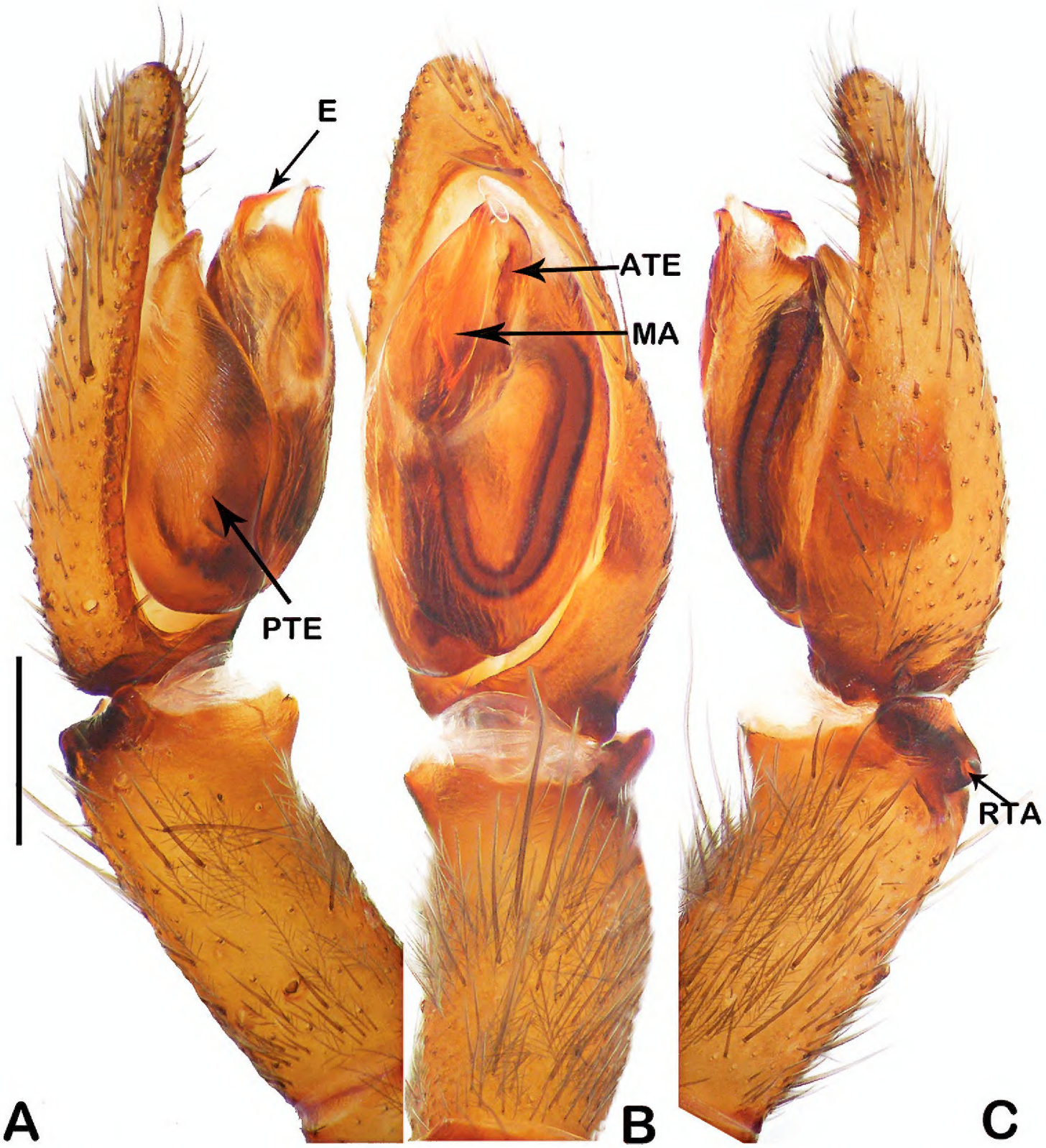

Figure 6. *Toxoniella waruii* sp. nov., left palp, male holotype **A** prolateral **B** ventral **C** retrolateral. Abbreviations: ATE anterior tegular extension, E embolus, MA median apophysis, PTE posterior tegular extension, RTA retrolateral tibial apophysis. Scale bar: 0.25 mm.

distally pointed median apophysis (Fig. 6A–C; Warui and Jocqué 2002: fig. 10). Females of *T. waruii* sp. nov. resemble *T. taitensis* by the fairly elongate epigyne with a wide groove but can be distinguished by a postero-laterally directed pair of anterior spermathecae, cul de sacs do not reach the anterior epigynal margin, and 'bursae' absent (Fig. 5A, B; Warui and Jocqué 2002: figs 7, 8).

Description. Male. Total length 7.20. Carapace 3.40 long, 2.52 wide, brownish orange, narrow at pars cephalica. Setae sparse, grey laterally with grey radiations from fovea. Cephalic area lacks pattern. Clypeus short, chelicerae, endites, and labium

colored as carapace. Eye diameters and interdistances: AME 0.16, ALE 0.13, PME 0.09 and PLE: 0.11, AME–AME: 0.04, AME–ALE: 0.03, PME–PME: 0.07, PME–PLE: 0.07, MOQ: AW: 0.13, PW: 0.18, Length: 0.16. Sternum longer than wide, heart shaped, colored as carapace, with strongly pointed post-coxal triangles. Abdomen with dense, grey setae, reddish brown near carapace. Venter pale yellow with two pairs of intermittent lines from epiandrum towards spinnerets. Leg measurements: I 6.57 (1.76, 0.82, 1.58, 1.24, 1.17), II 5.08 (1.30, 0.79, 1.20, 0.90, 0.89), III 4.96 (1.30, 0.60, 0.91, 1.13, 1.02), IV 7.59 (1.80, 0.95, 1.64, 1.86, 1.34). Anterior leg pairs have long curved setae, three on tarsus are longer. Tenent setae in 5–6 pairs. Leg spination I P–T v1–2–2 Mt v2–2–2; II: P–T v0–1–2 Mt v2–2; III: F P–T pl2, d2, rl2, v2–2–1 Mt 8; IV: P v1 T pl2, d1, rl2, v2–2–2. Palp (Fig. 6A–C). RTA a curved ridge, wrench shaped posteriorly (Fig. 6C). Embolus bent, with a membranous, looping sclerite, anterior and posterior tegular extensions distinct. Median apophysis flat and distally pointed (Fig. 6B).

Female. Similar to male in coloration except darker and larger. Total length 7.20. Carapace 3.40 long, 2.20 wide. Eye diameters and interdistances: AME 0.17, ALE 0.13, PME 0.10 and PLE: 0.11, AME–AME: 0.04, AME–ALE: 0.03, PME–PME: 0.07, PME–PLE: 0.07, MOQ: AW: 0.13, PW: 0.18, Length: 0.16. Leg measurements: I 6.61 (1.78, 0.82, 1.58, 1.23, 1.20), II 5.06 (1.30, 0.80, 1.20, 0.90, 0.86), III 4.97 (1.29, 0.60, 0.93, 1.14, 1.01), IV 7.63 (1.80, 0.98, 1.64, 1.87, 1.34). Tenent setae pairs and leg spination as in males. Abdomen grey, wider than in males. Epigyne (Fig. 5A, B). Ventrally sclerotized, brown and dark in some areas. Outline of spermathecae in dorsal view is visible through epigynal plate. Anterior epigynal margin smoothly curves downwards (Fig. 5A). Two pairs of spermathecae, posterior pair larger than anterior pair which are slightly postero-laterally directed. Epigynal groove longer than wide. Cul de sacs about anterior margin of the epigyne.

Etymology. The species name is dedicated to Dr Charles Warui, a Kenyan ecologist who established and described the genus and two species; noun (name) in genitive case.

Distribution. Known only from the type locality.

***Toxoniella nyeri* Oketch & Li, sp. nov.**

http://zoobank.org/37EAAA94-42E2-4C29-980B-13AC0616545F

Figs 7A–D, 8A, B, 9A–C

Material examined. ***Holotype*** Kenya • ♂; Nyeri County, Naro Moru Town, Mount Kenya National Park, Naro Moru Gate, Metrological station; 00.1702°S, 37.214°E; 3000 m; 6 Aug. 2018; Kioko G. & Oketch A.D. leg. ***Paratypes*** Kenya • 1 ♂, 3 ♀; same data as holotype.

Diagnosis. Males of *Toxoniella nyeri* sp. nov. can be distinguished from other congeners by the talon-like RTA, the large, pointed embolus, and the apically membranous median apophysis (Fig. 9A–C). Females are similar to other members of this genus by having two pairs of spermathecae, with the posterior pair larger than the

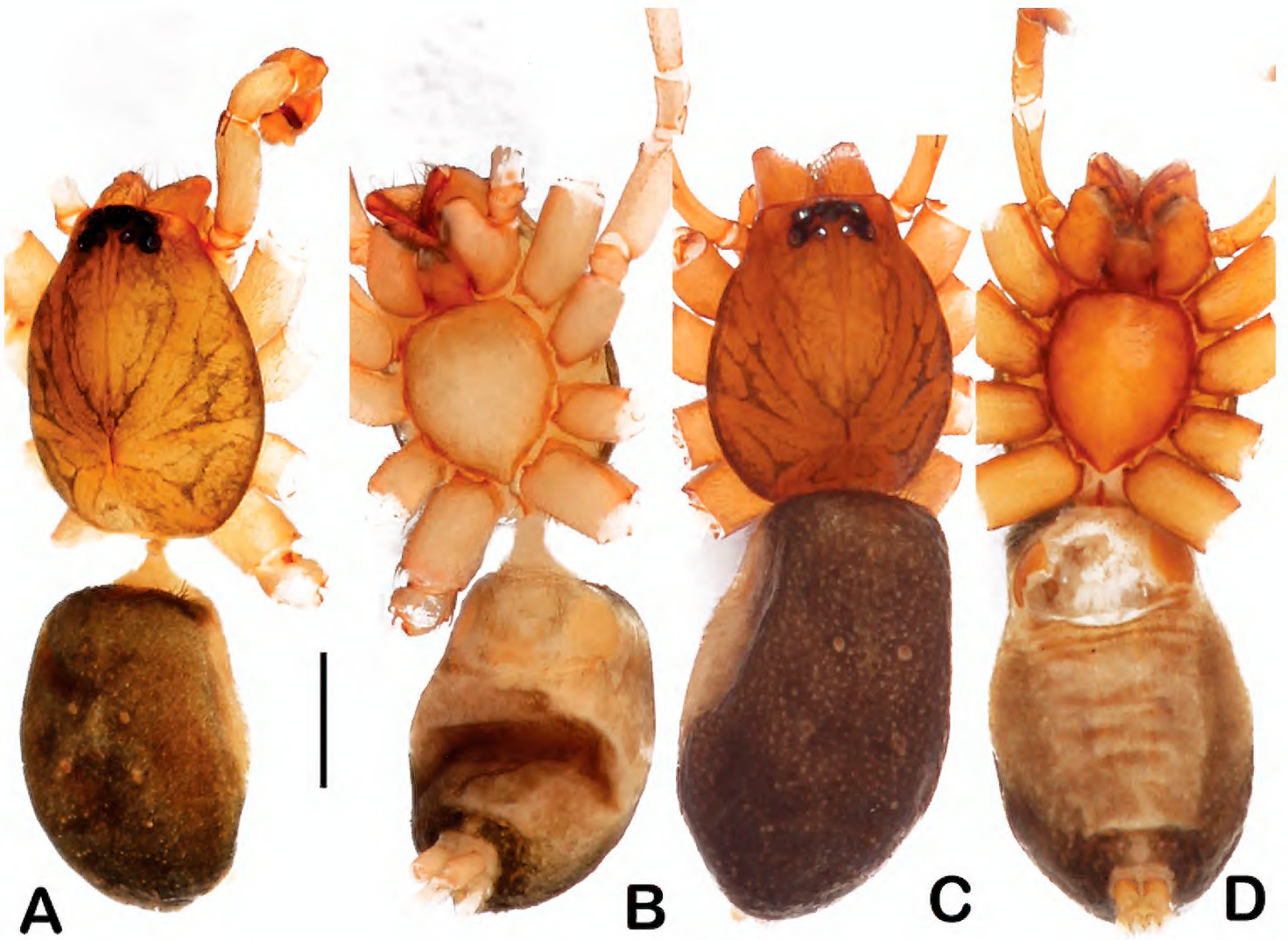

Figure 7. *Toxoniella nyeri* sp. nov., habitus, male holotype (**A, B**) and female paratype (**C, D**) **A, C** dorsal **B, D** ventral. Scale bar: 1 mm.

anterior pair. However, they can be differentiated from the other species as the cul de sacs are longer in *T. nyeri* sp. nov. than in *T. waruii* sp. nov. and *T. tharaka* sp. nov. In addition, *T. nyeri* sp. nov. have a patterned carapace that forms a Ψ-shape with the fovea in both males and females (Fig. 7A, C).

Description. Male. Total length 6.83. Carapace 3.20 long, 2.34 wide, orangish brown with dark net-like pattern; with two dark lines towards either of the posterior median eyes. Fovea dark brown. Clypeus vertical and short, yellowish brown, as are chelicerae. Eye diameters and interdistances AME: 0.15, ALE: 0.12, PME: 0.13, PLE: 0.13, AME–AME: 0.05, AME–ALE: 0.04, PME–PME: 0.12, PME–PLE: 0.11, MOQ: AW: 0.26, PW: 0.34, Length: 0.27. All eyes have dark pigment around them. Sternum pale yellow, heart shaped, longer than wide. Precoxal triangle weakly pointed. Labium longer than wide, approximately twice the length of endites. Abdomen dorsally grey with thick, short setae. Venter greyish. Leg measurements: I 6.42 (1.70, 0.73, 1.59, 1.20, 1.20), II 5.10 (1.30, 0.75, 1.27, 0.87, 0.91), III 4.97 (1.32, 0.66, 0.90, 1.10, 0.99), IV 7.49 (1.76, 0.91, 1.64, 1.81, 1.37). Anterior leg pairs have long, curved setae. Tenent setae in 5–6 pairs. Leg spination; most of the spines have been detached; III: P–T pl2, d2, rl2, v2–2–2 Mt 10; IV: P v1 T pl2, d1, rl2, v2–2–2. Palp (Fig. 9A–C), RTA ridged; dorsal talon-like; ventral blunt, mound-like. Embolus large, curving, originating at 9 o'clock

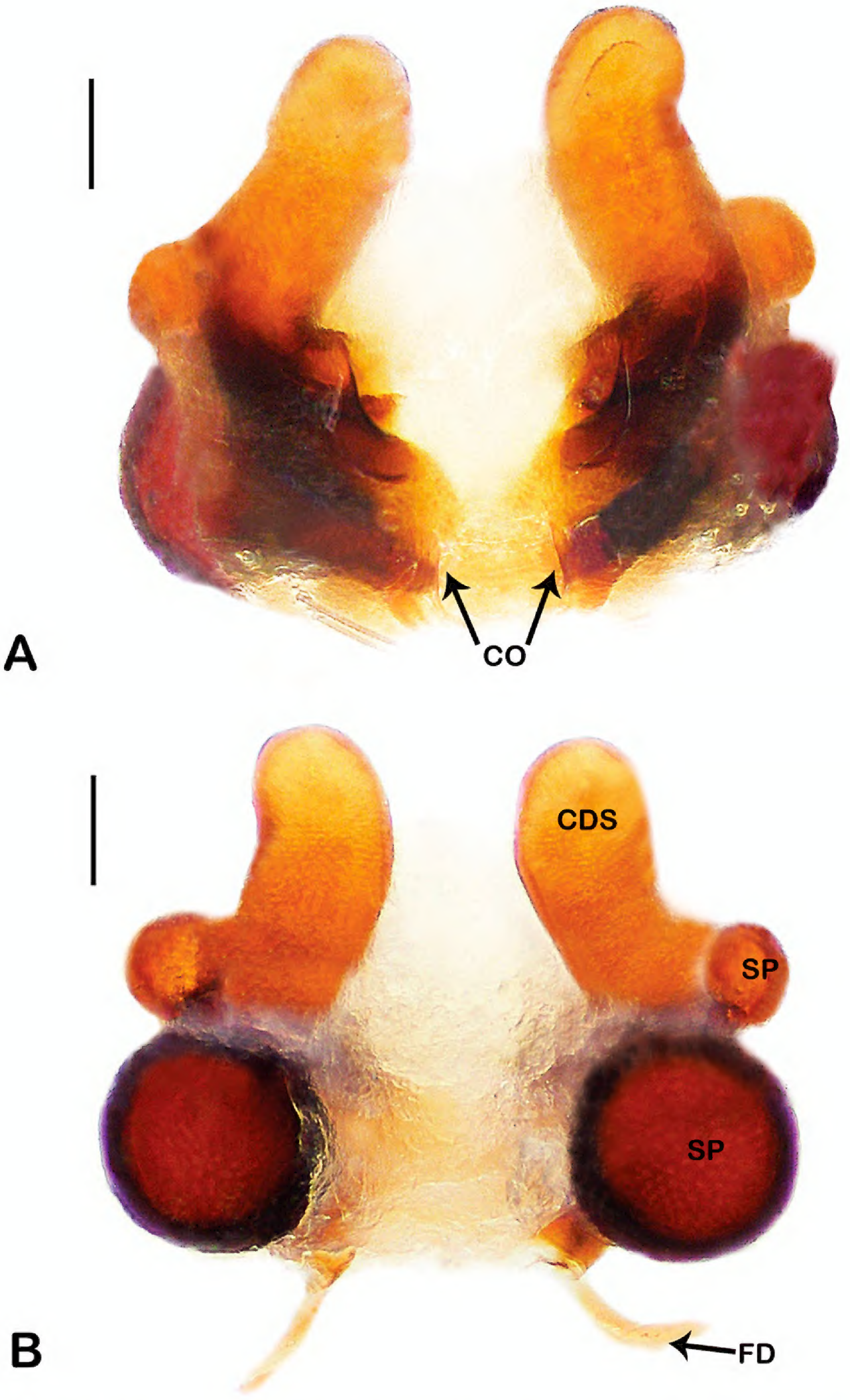

Figure 8. *Toxoniella nyeri* sp. nov., epigyne, female paratype **A** ventral **B** dorsal. Abbreviations: CDS cul de sac, CO copulatory opening, FD fertilization duct (interfered with during manipulation), SP spermatheca. Scale bars: 0.25 mm.

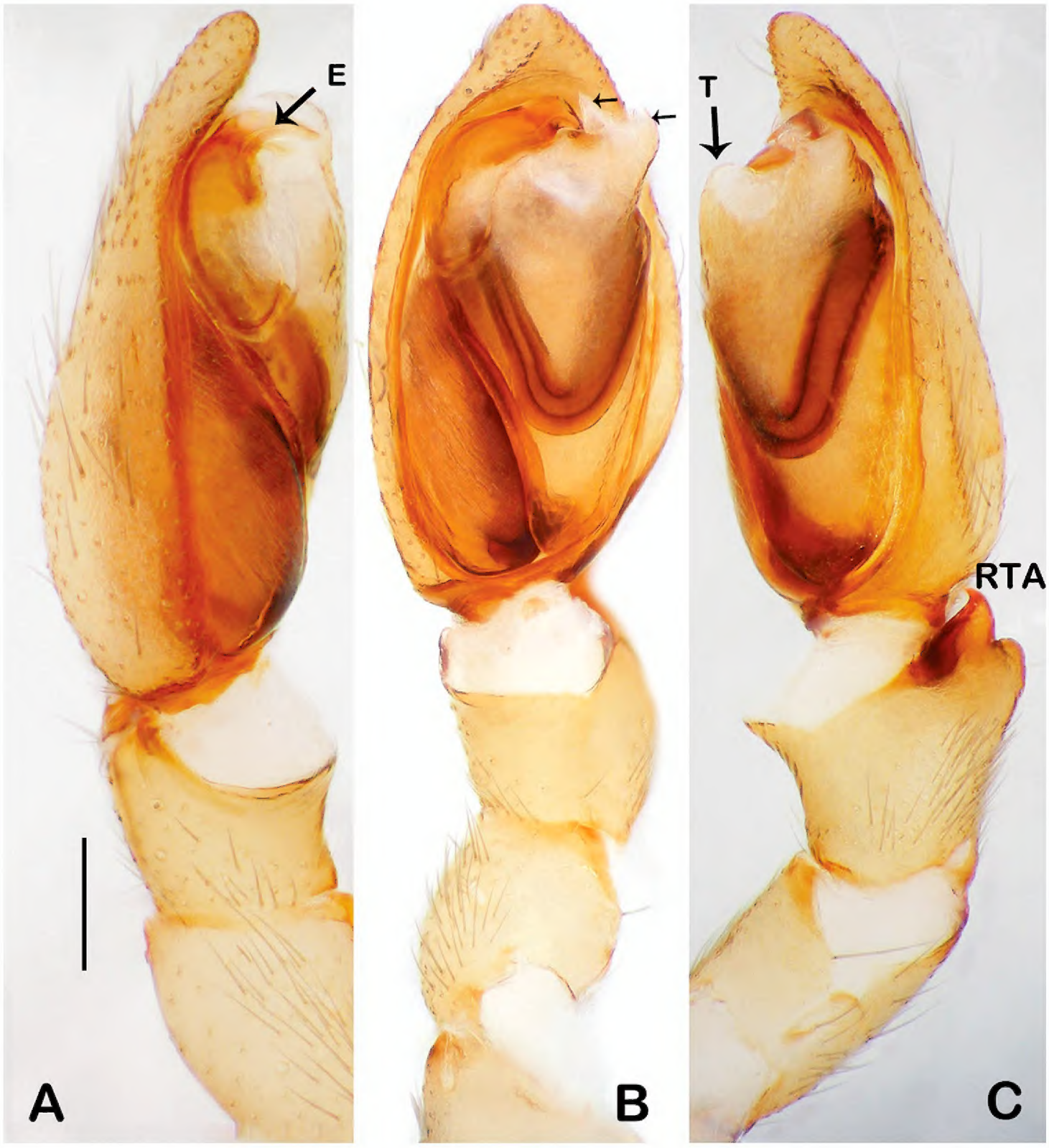

Figure 9. *Toxoniella nyeri* sp. nov., left palp, male holotype **A** prolateral **B** ventral **C** retrolateral. Abbreviations: E embolus, RTA retrolateral tibial apophysis, T tegulum. Scale bar: 0.25 mm.

position. Membranous median apophysis obscuring some parts of embolus in retrolateral view. Sperm duct forms a V-shape.

Female. Slightly larger and darker than male. Total length 6.90. Carapace length 3.41, width 2.59, color and pattern as in male. Eye diameters and interdistances AME: 0.15, ALE: 0.12, PME: 0.13, PLE: 0.12, AME–AME: 0.05, AME–ALE: 0.04, PME–PME: 0.13, PME–PLE: 0.12, MOQ: AW: 0.26, PW: 0.34, Length: 0.27. Sternum pale brown. Pre-coxal triangles as in male. Leg measurements: I 6.36 (1.70, 0.71, 1.59, 1.20, 1.16), II 5.10 (1.30, 0.75, 1.27, 0.87, 0.91), III 4.98 (1.32, 0.66, 0.90, 1.10, 1.00), IV 7.46 (1.74, 0.91, 1.64, 1.80, 1.37). Tarsal tenent setae as in males. Leg spination III:

P–T pl2, d1, rl2, v2–2–2 Mt 11; IV: P v1 T pl2, d1, rl2, v2–2–2. Epigyne (Fig. 8A, B) dark reddish brown and strongly sclerotized. Copulatory openings small, relatively close together. Cul de sacs quite elongated, anterior spermathecae very small, approximately three times the diameter of the posterior pair. Epigynal groove wide.

Etymology. The species is named after type locality; noun in apposition.

Distribution. Known only from the type locality.

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